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SIPHOGENERITA, NEW GENUS, AND A REVISION OF CALIFORNIA CRETACEOUS "*SIPHOGENERINOIDES*" (FORAMINIFERIDA)

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Topotype material of all California species and subspecies of *Siphogenerinoides* was recently obtained by our laboratory. A. R. Loeblich, Jr., called the attention of the writer to certain discrepancies between the type species, *Siphogenerinoides plummeri* Cushman and the California species. A subsequent study of topotypes of *S. plummeri* and a survey of the literature concerning *Siphogenerinoides* demonstrated the presence of these inconsistencies. In view of the importance of this genus to California biostratigraphy it was decided to restudy the internal morphology of the test, particularly the arrangement of the early chambers and the siphon in order to clarify the somewhat doubtful systematic position of the California species of *Siphogenerinoides*.

The writer gratefully acknowledges the help received from several persons. A. R. Loeblich, Jr., California Research Corporation, La Habra, California, provided some of the material and also suggested the present study. William Lewis, Standard Oil Company of California, Oildale, California, supplied type material from two localities in California. Helen Tappan Loeblich, University of California at Los Angeles, drew the text figure and two figures on the plate and critically read the manuscript. Other illustrations were prepared by Lawrence Isham, scientific illustrator, Washington, D. C.

The genus *Siphogenerinoides* was introduced by Cushman in 1927. As type species he selected *Siphogenerina plummeri* which he had first briefly mentioned in a paper on the genera *Siphogenerina* and *Pavonina* (1926a: 18). Comparing it to the Recent *Siphogenerina australiensis*

Cushman wrote: "There is a very slender species with numerous uniserial chambers and 10 to 12 costae, which occurs in the Navarro, Upper Cretaceous clays, one-half mile south of Kemp, Texas. This may be known as *Siphogenerina plummeri* Cushman, new species, and will be figured later."

Siphogenerina plummeri was described and figured later in the same year (Cushman, 1926b: 15) and a specimen was designated as holotype from the Upper Navarro, exposed along Walker Creek in Milam County, Texas. No mention was made as to the presence or absence of an internal tube. Without reference to any generation, the early stage was described as being biserial.

One year later Cushman published his outline of a reclassification of the foraminifera wherein he proposed the genus *Siphogenerinoides* with *Siphogenerina plummeri* as type species (Cushman, 1927: 63). At this time he positively stated the absence of siphons between the chambers and again mentioned the biserial initial stage.

The first adequate description of *Siphogenerinoides plummeri* was given by Plummer (1931: 183). Excepting some modifications concerning the internal tube, nothing can be added to her observations. Of great interest are Plummer's conclusions as to the generic affiliations: "The genotype of *Siphogenerinoides* is here placed in the family Buliminidae Cushman, of which the internal tube is a fundamental character. Whereas *Siphogenerina,* characterized by its triserial initial stage, has probably evolved from *Bulimina* through *Uvigerinella* with its collared aperture and *Uvigerina* with its aperture bounded by a neck and phialine lip, *Siphogenerinoides* has probably arisen through bolivine stock. The frequent twisting of the earliest biserial chambers of the microspheric test is possibly an inheritance from *Virgulina* and *Bolivina.* The basic characters that differentiate *Siphogenerinoides* from *Siphogenerina* are, therefore, the biserial arrangement of numerous early chambers of the microspheric form."

Galloway's manual (1933: 379) listed *Siphogenerinoides* as a synonym of *Siphogenerina.*

In his monographic treatment of *Siphogenerinoides,* Stone (1946) reached the conclusion that the two genera are to be separated because of the differences in their apertural features. He considerably emended Cushman's original definition of *Siphogenerinoides* and included the statement that the early chambers of the microspheric form of S. *plummeri* were triserial exhibiting an irregular configuration.

The last edition of Cushman's *Foraminifera, Their Classification and Economic Use* (1948: 260), again mentions biserial initial chambers for *Siphogenerinoides.*

In a careful analysis of the internal structure of *Siphogenerinoides plummeri* Montanaro Gallitelli (1957: 148) confirmed the biserial arrangement of the early stage. She maintains that, "a relationship of *Siphogenerinoides* with triserial genera must be excluded."

Recently, I was able to examine a large number of topotypes of

Siphogenerinoides plummeri. In order to obtain a better view of the initial chambers and the internal tube Troelsen's acid treatment (1954) was successfully utilized. With the chamber walls eroded in this manner all specimens examined showed an unquestionably biserial *Bolivina*-like arrangement just as described by Plummer and Montanaro Gallitelli.

To date, two species and one variety of *Siphogenerinoides* have been reported from California, namely *Siphogenerinoides clarki* Cushman and Campbell, 1936 (see attached plate, Figs. 5, 6, 10a,b,c), *Siphogenerinoides clarki* Cushman and Campbell var. *costifera* Cushman and Goudkoff, 1944 (= Figs. 8a,b,c,g, herein) and *Siphogenerinoides whitei* Church, 1941 (see Figs. 4a,b,c, 6, herein). Examining the original descriptions one notes that in all three cases the early chambers of the microspheric generation are clearly stated to be triserial. For the present study large samples of topotype material were available and therefore hundreds of microspheric tests were treated with hydrochloric acid. Without exception, the neanic stages of the three species were found to be triserial. The internal siphon, however, appears to be formed in the same way as in *Siphogenerinoides plummeri* (Figs. 1a,b, 2, 3a,b, herein). As observed by Montanaro Gallitelli (1957) the internal "tube" is not a complete cylinder, but a spoutlike hemicylinder connecting the foramen on the upper and lower side of a chamber. But this spout does not extend through the openings as it seems to pierce the septal wall in a separate small circular hole in such a manner that the concave side of the spout faces the foramen (see text, Fig A). There is not a single continuous, twisted spout present throughout the whole length of the test because the spouts grow visibly out of each septal wall or rather out of the lip or weltlike structure surrounding the aperture. The position of attachment of the spout connecting two chambers is diametrically opposite because the position of successive openings is axially oriented at the rate of 120°–180°.

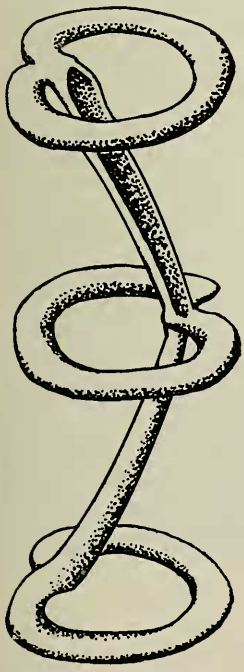
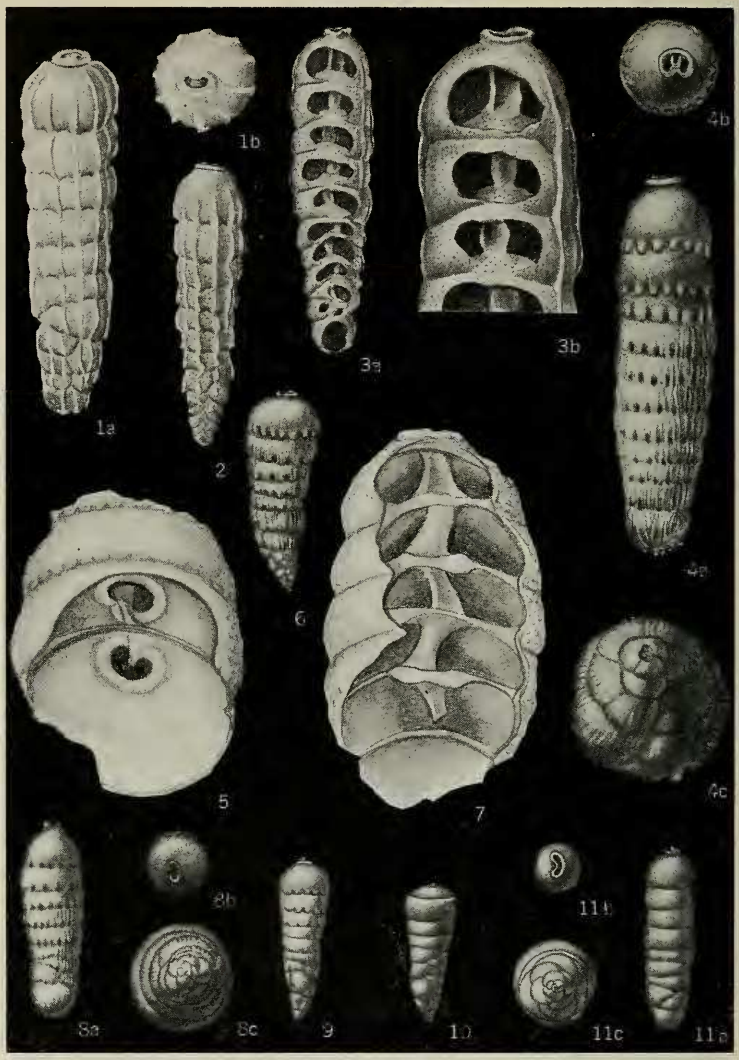


Fig. A. Portion of the columellar process and apertural rim in *Siphogenerita whitei*.

From this closer examination of the internal structure of the Californian species of "*Siphogenerinoides*" thus emerge two relationships:

1. With the genus *Siphogenerinoides*, because of the columellar process and apertural features, and also the general test morphology.

2. With *Siphogenerina*, because of similarity of test and the triserial neanic stage in the microspheric generation.



FIGS. 1–3. *Siphogenerinoides plummeri* (Cushman) topotypes (USNM P5453) from the Upper Cretaceous, Navarro group, in the bank of Walker Creek, 6 miles N 15° E of Cameron, 1 mile upstream from the intersection of Walker Creek and the Cameron-Clarkson road, Milam County, Texas. Collected by H. J. Plummer. Figs. 1a, 2—sideviews; 1b—top view (all ×73). Fig. 3a—sectioned topotype (USNM P5455), showing internal tube (×73). Fig. 3b—enlarged upper part of the same specimen (×143).

Since no biserial microspheric specimens have been found among the Californian species and on the other hand no triserial microspheric generation of *Siphogenerinoides plummeri* is known, dimorphism is to be ruled out. It appears then that in spite of their similarities to *Siphogenerina* and *Siphogenerinoides* the California species cannot be placed in either genus but must be allocated to a new genus for which the name *Siphogenerita* is proposed. Because of its triserial early chamber arrangement the new genus is here included in the family Uvigerinidae.

Order Foraminiferida Zborzewski, 1834
Superfamily Buliminacea Jones, 1875
Family Uvigerinidae Cushman, 1913
Genus **Siphogenerita** Furrer, new genus

Type species: Siphogenerinoides clarki Cushman and Campbell, 1936.

Test free, elongate, length up to 2.3 mm. Circular to subcircular in transverse section, megalospheric forms well rounded at both ends, microspheric forms rather distinctly tapering. Early stage in microspheric generation triserial, passing into a relatively short biserial stage, then uniserial. Megalospheric forms with large proloculum followed by biserial and uniserial stages. Chambers somewhat inflated, sutures distinct, depressed. Wall calcareous perforate, finely porous, frequently ornamented with longitudinal costae or striations. Columellar process consisting of spoutlike hemicylinders changing the position of their convex side at a rate of 120°–180° in each successive chamber. Spouts do not pass

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Figs. 4–7. *Siphogenerita whitei* (Church) from top of cored interval 325–335 feet, Marca No. 3, near the center of Sec. 6, T. 15 S, R. 12 E, Mount Diablo Baseline and Meridian, Panoche Quadrangle, Fresno County, California. Fig. 4a—sideview of megalospheric test; 4b—apertural view; Fig. 6—side view of microspheric test; all ×20.5. Fig. 4c—view of early chamber arrangement in microspheric test, ×41. Figs. 5, 7—dissected tests showing alternating position of the semicylindrical spouts and the foramen in successive chambers (×48).

Figs. 8–9. *Siphogenerita clarki* (Cushman and Campbell) var. *costifera* (Cushman and Goudkoff) from a core at interval 6971–80 feet in Jergins Oil Cheney Ranch No. 1 Well, in Sec. 29, T. 14 S, R. 13 E, Fresno County, California. Fig. 8a—sideview of megalospheric test; Fig. 8b—apertural view; Fig. 9—sideview of microspheric test; all ×20.5. Fig. 8c—view of microspheric early chamber arrangement (×41).

Figs. 10–11. *Siphogenerita clarki* (Cushman and Campbell) from Marsh Creek at the bend just below mouth of Briones Creek, S ½, SW ¼, NW ¼, Sec. 35, T. 1 N, R. 2 E, Mount Diablo Baseline and Meridian, Byron Quadrangle, Contra Costa County, California. Fig. 10—sideview of microspheric test; Fig. 11a—sideview of megalospheric test; Fig. 11b—apertural view; all ×20.5. Fig. 11c—view of microspheric early chamber arrangement, ×41.

through foramen but grow out of the welt- or liplike structure surrounding the aperture, thus not forming an uninterrupted, continuous siphon. The concave side of the spout always faces the apertural opening. Aperture terminal, elliptical, or reniform with short neck and distinct lip. Terminal feature of columellar process is a small circular opening outside aperture and adjacent to its concave side.

Occurrence: Upper Cretaceous, Coniacian–Maestrichtian.

Remarks: Siphogenerita, new genus, differs from *Siphogenerinoides* in having a triserial initial chamber arrangement. The spoutlike hemicylinders forming a discontinuous siphon which does not pass through the foramen distinguish the new genus from *Siphogenerina.*

From a study of the literature and without having examined actual material it seems evident that most western hemisphere species of *Siphogenerinoides* must be placed with *Siphogenerita.* This applies in particular to the species from Peru erected by Stone (1946), Cushman's Venezuelan species (1929) and the forms described by Petters (1954) and Redmond (1955) from Colombia. *Siphogenerinoides cretacea* Cushman subsp. *idkyensis* Colom, 1948, first reported from the Upper Cretaceous of the Spanish Sahara undoubtedly belongs to *Siphogenerita.* In a recent paper (Chenouard, de Klasz and Meijer, 1960: 71) two new species, *Siphogenerinoides clavata* and *Siphogenerinoides dentata* were described from the Upper Cretaceous of West Africa. Diagnosis and illustrations clearly demonstrate them to be *Siphogenerita.*

Siphogenerinoides oveyi Nakkady and *S. oveyi* var. *compressa* Nakkady (1950) both found in the Upper Cretaceous of Egypt are apparently true *Siphogenerinoides.* This survey of the literature indicates that a number of synonyms occur among species of *Siphogenerinoides* and *Siphogenerita* respectively, but without an examination of the material no changes will be suggested at present.

We are facing here a somewhat similar situation to that which existed prior to 1945 for *Siphogenerina* which then included forms with biserial as well as triserial neanic chambers in microspheric tests. Mathews (1945: 588) separated these, leaving those with biserial neanic chambers as *Siphogenerina* and erecting for those with triserial early stage the new genus *Rectuvigerina* (which was divided into two subgenera *Rectuvigerina s. s.* and *Transversigerina,* on the basis of shape of the sutures). There is, however, a certain difference between the splitting of *Siphogenerina* and *Siphogenerinoides* because dimorphism undoubtedly occurs in the former. Bandy (1952: 17) reported both tri- and biserial tests among specimens of *Siphogenerina costata* from its type area in the south Pacific Ocean (Tahiti).

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